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THE GEOLOGICAL HISTORY

of

ST. JOSEPH COUNTY, INDIANA

as exhibited by the

Glacial Remains, Ancient and Present Waterways, and Stream Changes in this Locality.

BY HUGH T. MONTGOMERY, M. D.

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THE GEOLOGICAL HISTORY
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Glacial Remains, Ancient and Present Waterways, and Stream Changes in this locality.
or THE EARLY HISTORY OF OUR HOME
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MANY years ago, there was raised up out of the Ocean, a strip of land along the eastern border of North America, lying east of the eastern slope of the Appalachian range of Mountains, and extending to an unknown distance northeastward; also a land mass comprising all of Labrador, and most of the Canadas, extending in a northwesterly course to the upper border of the present outline of North America, thus forming a V shaped body of land. There was also a long narrow strip of land located about the central part of the western half of the present continent. These masses of land are known to be the oldest of the continent, by their being composed of the oldest rocks presented on the earth's surface, and by all other rocks being found lying upon, or above them. Between these strips of land on the east and the west, there remained yet a vast ocean; this was the interior or Great Palæozoic Sea. The age was known as the Archæan period, or the beginning. At this time there was being spread upon the bottom of this interior sea, the lime, sand, mud, and shell deposits, which were to constitute the series of stratified rocks which now lie beneath us. But the bed of this interior sea with the land masses which had already emerged was destined to become a great continent. The Archæan lands were pushing higher and higher, and the interior sea was becoming more and more shallow; finally, after the lapse of ages, the sea bottom began to peep above the waters, and the surface of Indiana for the first time in the history of the world, so far as has been revealed to the mind of man, first appeared as dry land. From this time on, through a long series of years, it was alternately depressed and re-elevated. During its periods of elevation, its surface was covered with a dense growth of semi-tropical plants and forest timber. The general surface of the land was low, level and swampy, and upon slight depression was easily overspread by the seas, engulfing and covering its growth of vegetation with sediment, forming our coal beds. This alternating sea and land surface continued for millions of years, or, until the close of the Carboniferous or coal-making age, when the Appalachian range of mountains began to make their appearance by the folding and crumpling of the earth's surface along the eastern border of the great interior sea. The elevation of this mountain range out of the sea, with the consequent moderate elevation of adjoining regions to the west, permanently raised the surface of Indiana above the level of the ocean, by the end of the Palæozoic era. From that time until the Glacial Period, a time computed by geologists to have been many millions of years, a time at least sufficiently long for four miles in thickness of the Appalachian range of mountains to be removed by subaerial decay and erosion, the surface of Indiana was subject to sunshine and shadow, rains, snows and frosts, forests covered the uplands, and swamps were present in the lowlands, streams intersected its surface, and all was perhaps little unlike that which has occurred since the history of man. During these immense ages, the surface of the rocks raised up out of the seas, decayed by subaerial disintegration and chemical solution, to great depths, and was eroded and channeled by the streams, until the surface of Indiana presented an extremely broken and desolate appearance, with numerous gullies, canyons and waterfalls, with all streams flowing over rock bottoms, much as we find the present condition of the lower third of the state, but in a more exaggerated form, from the fact that the glacial drift from the upper two-thirds of the state has served by overflow washings to modify much of its former rugged and uneven character. The great trough of the Ohio River is one of the remains of this period, it being from one to four miles in breadth and from four to five hundred feet deep; also the lower part of the Wabash river, with many other small Indiana tributaries of the Ohio river. Yet these streams all show vastly greater depths for the ages before the glacial epoch, having since been silted up from one to several hundred feet. There must have been broad and deep water ways through the central and northern portions of Indiana. The uncovered portion of the Wabash trough, shows the trunk drainage from the southern and west central portions. The original surface of Indiana was not a perfect level, but was raised into an arch, the crest of the arch extending from Union county on the eastern border of the state, a little south of the center, to Lake county on the northwestern border. The crest of this arch forms the limestone ledge over which the Kankakee flows as it emerges from the state, and is most conspiciously shown at Momence, just over the line in Illinois. If the surface of the state were not heavily overlaid by drift from glacial ice, this linear arch dividing the state diagonally from the southeast to the northwest, would probably show the ancient drainage to be different from what it is today. The waters north of the crest would be led through broad and deep channels north or northwesterly into a great water course supposed by geologists to have occupied the region of the Great Lakes, flowing to the east through Georgian Bay and by the way of the St. Lawrence trough to the sea; the St. Lawrence valley at that time being a great arm of the sea.

Borings and excavations through the northern part of the state show pre-glacial valleys at many places, but the miscellaneous borings heretofore made have not been sufficient to trace their course and termination. In sinking our wells for city water supply, we penetrate a bed of coarse river gravel lying upon the shale or original country rock, which is unquestionably a pre-glacial river bed of large capacity, and undoubtedly the trunk stream which afforded drainage for all the territory lying north of the arch or elevation which at that time divided the state into two drainage surfaces.

These pre-glacial valleys have all been filled, and their gravel bottoms hermetically sealed by clay laid down during the ice period. The waters flowing through these gravel streams, crop out at the border of the glacial drift and eroded valleys as springs, their source or fountain head being sufficiently elevated that when borings are made along their course, the result is a flowing well. This is the source of our city's (South Bend) supply of pure water.

From the close of the Palæozoic era, or when the surface of Indiana was permanently raised from the sea, to the commencement of the glacial period, time was measured by millions of years. During this long period, the surface of Indiana was transformed from a comparatively level, swampy area into one of great river valleys, hills, buttes and table lands, with all the varied scenery of a surface long exposed to aqueous and subaerial solution and consequent erosion. Also the great mountain chains of the west were given birth, and pushed their towering heads toward the sky, and six miles in depth of some of their rocky surfaces during this time disintegrated, eroded and were again returned to the seas by mountain streams. The up-heaval of the several chains of mountains in the west, the consequent elevation of adjoining surfaces, forming a gradual decline to the east, meeting the gradual decline westward from the Appalachian Mountains, drained the remainder of the interior sea and constituted the great interior valley, or Great Plains, drained by the Mississippi and its tributaries. This gave to the continent of North America largely its present geographical lines or contour.

In a few words we have attempted to follow the continental changes which have occurred during a long period of time, from the Archæan era, to the close of the Tertiary period. The mere statement of those figures, is appalling, and almost incomprehensible. Conservative geologists and scientists, estimate the lapse of time from the closing of the Archæan era, to the end of the Palæozoic, or until the appearance of the Appalachian range, at fifteen millions of years, or one-half of the time from the Archæan era to the present time, making a total lapse of thirty millions of years since nature began the construction of the North American continent, and fifteen millions of years since Indiana, our home, was raised from the bottom of the sea, and became permanently dry land. Geologists arrive at these figures by mathematical calculation. By a careful observation of the surface of continental lands, and measurements of depths of erosion, it is found that at least six thousand feet in depth of surface has been eroded, gathered by rivulets, and transported by the larger streams to the sea. They have also determined the carrying capacity of streams, by measuring the amount of sediment carried at different seasons of the year, and at various stages of high and low water, and find that it requires about five thousand years to remove an average thickness of one foot from the continental surface. Then, if five thousand years are required to remove one foot, to remove six thousand feet would require thirty millions of years. This estimate is considered by geologists to be an under, rather than an over estimate of time.

THE GREAT ICE AGE

We now come to the last great epoch which impressed its individuality upon the surface of Indiana, and gave to it, its present facial contour, "The Great Ice Age." During the earlier part of the Quaternary period the crust of the earth was subject to varied and wide-spread oscillations, elevations and depressions. Elevations were most marked in higher latitudes; and on our own continent most marked through the north central portion, comprising Labrador, the Canadas, and the great lake region. These oscillations were attended by great changes in climate, the elevated regions being subject to great frigidity. The territories mentioned lying immediately north of us, sustained an elevation of from two to three thousand feet, and from continued snow fall during a long period of time, became covered with ice to a depth of from five to fifteen thousand feet, known as the Great Continental Ice Sheet, which extended south, near Cincinnati, a few miles below the Ohio river. From this point the lower border of the ice sheet took a northeasterly and northwesterly course, northeasterly to the coast line near Long Island, northwesterly into the British possessions, where it has not been accurately traced. The cause of the great glacial, or ice epoch, is not fully understood, being attributed to various causes, and to an aggregation of conditions. But the fact remains that at that time there was a marked elevation of the Laurentian area, which, is in itself, a strong factor in the production of a more severe climate. The climatic condition of the regions north of the Great Lakes, about Hudson's Bay and Labrador, were favorable at that time for continual snows, which condition existed through long ages. The short summer suns had little effect in dissipating them, other than to reduce the vast snow field to glacial ice; and as ice began to pile up to thousands of feet in thickness, the known glacial movements commenced, and the great ice flow started southward. The ice mass being of great weight, and frozen solidly to the surface upon which it rested, in its slow and tedious movement onward, it carried or dragged everything movable with it. The under surface being literally a stony mass, as it moved onward, it scoured, grooved and polished every surface over which it passed, leveling and pushing onward all loose earthy or rocky material found in its pathway. The great creases or channels in the surface rock produced by previous stream erosion, were partially obliterated by glacial erosion and partially filled by glacial rubbish. As the ice sheet approached and passed into the valleys of the Great Lakes, its lower margin became lobated, and each lobe took a course largely in the direction of the lake valley, but as they emerged, they began to coalesce, forming again an almost unbroken front, pushing onward to the south with its load of boulders, gravels, sands and clay. As the ice sheet traveled south to lower latitudes it was gradually approaching a warmer climate, where the loss by melting at its border, and from its surface, equalled its production at the ice center. This balance of energies brought its onward movement to a close, and caused the ice border to remain more or less stationary, probably for thousands of years. At this fixed point the ice yielded up its glacial waters which rolled onward to the sea through the great central water-way, the Mississippi river. The Laurentian ice sheet was practically a homogeneous mass, composed of ice, rock, clay, sands and gravel. The immense forests covering the surface of the country, were also swallowed up and ground to impalpable dust, in the crushing, grinding mill of glacial action, as few pieces of wood are ever found among the bones of glacial remains.

Under the great weight of thousands of feet of ice extending over a wide territory, the crust of the earth began to settle, and depression to the extent of from twelve to fifteen hundred feet below the present level was attained, during what is known as the Champlain epoch. A consequent milder climate prevailed, and the ice sheet began to withdraw to more northern latitudes, leaving its load of earthly material strewn over the surface the ice mass had formerly covered. The recession was slow and interrupted, being for short periods stationary, laying down our intermorainic ridges and broken ranges of hills. From careful observation of morainic surfaces, the glacial recession was much more rapid than its advance. The withdrawal continued until the border of the ice sheet lay north of the Great Lakes. Whether it receded sufficiently far north at this time to unlock the ice bound St. Lawrence, and re-establish drainage to the northeast is not known. The melting of this mountain of ice produced great floods and mighty streams, all pouring their waters to the south, as the St. Lawrence, the natural outlet of these waters was frozen solid and overlaid by thousands of feet of glacial ice. The waters were carried to the south through our locality, by four great channels, the Ohio, Wabash, Illinois, and the Desplaines. The Great Illinois River channel or valley has since been sub-divided into three segments, known as the St. Joseph, Kankakee, and Illinois rivers. The facts are that from Constantine, Michigan, to the Mississippi river was one continuous, unbroken waterway, except for the Kankakee and Lake Peoria basins. In glacial times it transported more water by far, than either the Wabash, Desplaines or Wisconsin rivers. Its great valley geologically, strikingly shows it. The four rivers just mentioned at the zenith of their fullness were mighty streams, any one of which was much larger than the Mississippi is to-day. And these, with the western tributaries, gave the Mississippi its great flood plain of thirty miles and more in breadth. Whether the withdrawal of the ice sheet to the north of the lakes was followed by a long period of milder or tropical time, or, whether an advancement to a point below the lakes immediately followed, is a question strongly debated by eminent glacial scientists. T. C. Chamberlain who made a geological survey of much of the glaciated territory of the United States, maintains that between the late Wisconsin ice movement and the one next preceeding it, there was a long period of time, accompanied by a warm sub-tropical climate; while other eminent glacial students contend that there was no extended lapse of time between the two glacial movements, and that while there was a moderation of climate sufficient to drive the ice sheet beyond the lakes, that nothing approaching a tropical climate prevailed. Let this be as it may, the fact remains, that the two glaciated areas present a vastly different appearance as to age, and indicate the lapse of many thousands of years between the two ice sheets. Glacial drift as deposited by the melting ice, is markedly undulating, presenting kames, ridges, sinks or kettle holes, presenting very much the appearance of the surface of Portage Prairie, or the region lying between South Bend and Cassopolis, with which localities you are all familiar, the surface being rolling, having sharp elevations and depressions, with numerous lakes among the hills dotting its surface. It is fair to presume that the general surface from the foot of the terminal Moraine of the last ice movement to the lower glacial boundary, when deposited by the melting ice, presented the same general characteristics; but, to the contrary, this intervening surface presents a monotonous aspect. It is almost a level plain, no hills, no knobs, no kettle holes, no deep valleys, while flat, shallow streams are the rule. Charles R. Dryer, in writing upon the geography of Indiana, gives this fitting description of the central third of Indiana:—"North of an irregular line extending in an irregular direction from Richmond to Terre Haute, and south of the westward flowing portion of the Wabash, from Fort Wayne to Attica, the topography is that of an almost featureless drift plain. The traveler may ride upon the railway train for hours without seeing a greater elevation than a hay stack or a pile of saw dust."

The time which has elapsed since that surface was laid down by the withdrawal of the first or Great Ice Sheet, is measured by so many thousands of years of aerial and aqueous erosion, that hills and ridges have been leveled to the surface, and its lakes have been filled by sedimentation and vegetable growth. This you will remember was during the Champlain epoch, or period of depression, when the surface abounded in shallow pools, swamps and lagoons; drainage was slow and interrupted, with a general inclination to a leveling of the surface. The great gorges and stream channels that had been eroded during the period of elevation were filled with river drift. When we compare the drift area north of the lower boundary of the last ice sheet, with the drift surface south of this line, a great difference in facial contour will be noticed. And when we contemplate the fact that at least from twelve to fifteen thousand years have passed since the laying down of the northern area with so little effect upon its rugged surface, it may not be a stretch of imagination to place the intervening time between the two ice periods at one hundred thousand years, rather more than less.

After the first ice movement, vast forests had again covered the uplands, and peat bogs had filled the depressions, all to be again crushed, ground and scraped from the surface by the last great ice advance.

LATE WISCONSIN ICE SHEET

This brings us to the culmination of the physical energies which gave us the present surface contour of St. Joseph county, to what is known as the Late Wisconsin Ice Sheet.

The conditions necessary to produce a humid atmosphere and great snow falls, were again present. Over the regions north of the Great Lakes, snow and ice began again to accumulate, until it reached thousands of feet in thickness, and from its own weight began to move as a tenacious, semi-liquid mass, down the southern slope. As it approached and entered the great lake basins, its onward movement was directed largely by the trend or direction of their basins. The Maumee [1] or Erie lobe took a west by southwest course, while from its southern border several smaller lobes pushed south and southwest. The ice lobe passing through the Huron basin, moved almost directly south. A part of the Huron lobe passing out at the foot of the basin, commingled its ice and load of earth and boulders, with the Erie lobe. From this fact, we find drift material from the northern Huron regions, such as drift-copper and porphyry conglomerate scattered over both Indiana and Ohio. And it also accounts for the heavy deposit of drift over the northeastern counties of Indiana, which attains a depth in some places of from four to five hundred feet. The great lobe that entered the Lake Michigan basin also passed almost directly south. Of the ice lobes to the west of the Michigan basin, we will not refer, as they do not immediately concern this locality. When we have spoken of the direction of each lobe, we refer to its axis, as the ice movement in these great basins was forward and to either side, radiating in an advance direction. The Erie lobe along its southern border presented a broad, and minor lobated border, the smaller lobes having pushed forward into the valleys of the streams entering the basin from the south, the main body of the ice passing southwestward along the general axis of the basin.

The Saginaw lobe was a large spur making its exit from the southwest margin of Lake Huron, scooping out that part of the basin known as Saginaw Bay. The Saginaw lobe was a long wedge shaped mass hemmed in on the west by the mighty Michigan lobe, and upon the east receiving the full force of the Erie and Huron mass in its southwestward movement.

Footnote 1:—The term, Maumee Lobe, as used in this paper, includes the outline of the united Erie and Huron lobes which entered northern Indiana and northern Ohio.

These ice tongues or lobes, after emerging from their basins, maintained their lobate characteristics, yet were united one with the other. The most southern line reached by the ice during this last movement extended a comparatively few miles below the Great Lakes, where it remained for a long period. The ice advancing with its load of earthy refuse from the north, being melted away as rapidly as it advanced to this line, laid down its burden of accumulated material, forming great ranges of hills or moraines, both terminal and lateral, definitely marking the outline of each glacial lobe. And, as the summers began again to predominate over the winters, the ice gradually withdrew to the north and disappeared from this locality, possibly forever. Owing to its being the youngest or most recent surface, in the region north of the terminal moraine, marking the advance of the last ice sheet, will be found almost all of our small inland lakes, which are the distinguishing mark of beauty of this locality. The lakes which once dotted the older glaciated surface of the central part of the state have long since filled by erosion or silted up. Before the northern ice overran our country, the soil of Indiana was composed of clay and fine sand, with lime, slate and sandstone pebbles; no granite boulders or pebbles at that time were present, they having been carried from the north and spread over this locality entirely through the agency of the ice sheet.

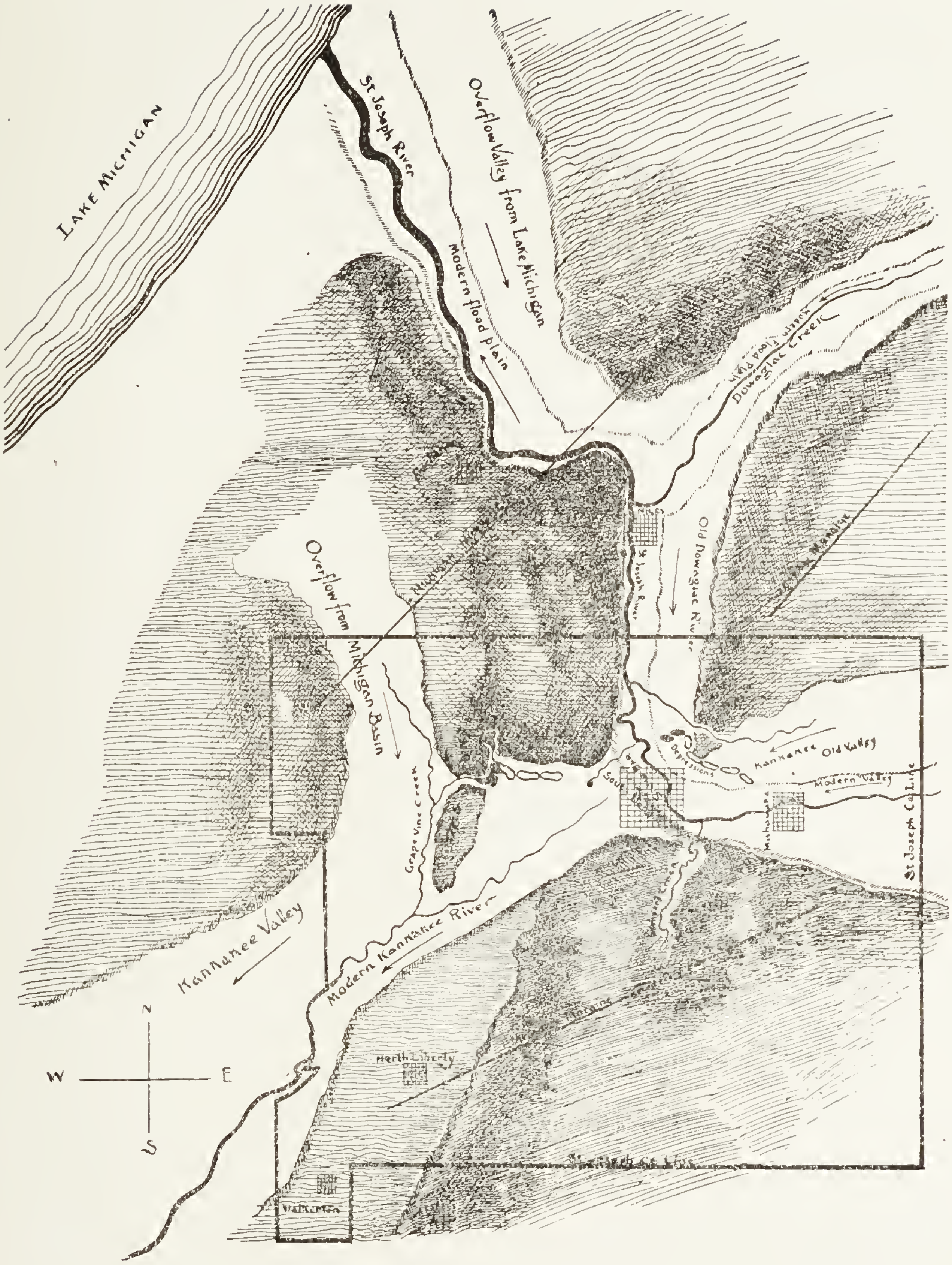
The Maumee ice lobe, Huron and Erie, taking a southwesterly course, advanced from the Lake Erie basin until its western extremity lay upon the southeastern counties of Michigan and the northeastern couties of Indiana, its southern border resting upon the northern counties of Ohio. The border of the Maumee lobe entered Indiana at the northeast corner of Elkhart County, took a westerly course through the northern part of Elkhart and St. Joseph Counties to a point five miles west of South Bend, where it began to angle to the south through the western part of the county, continuing along the western border of Marshall and Fulton counties, and on to the Wabash at Logansport, where it made an abrupt turn to the eastward, crossed the Wabash and continued through northern Indiana and Ohio. The withdrawal of this ice sheet and the depositing of its earthy and stony contents, mark the age of the lofty range of hills lying south of South Bend and Mishawaka. The Michigan lobe filled its basin and extended east from thirty to forty miles beyond the present shore line of the lake, where it curved southwest around the southeast margin of the lake. It overlapped the northwest corner of St. Joseph County and approached almost to our city limits. The highlands along the north bank of the Kankakee valley, Portage Prairie and the uplands west of Niles, known as the Valparaiso Moraine, which came into existence at that time, mark the eastern or southeastern border of the Michigan ice lobe, or terminal moraine. The Saginaw glacier advanced from the Huron basin through Saginaw bay, pushed south between the Michigan and Maumee glaciers, and reached a point one mile northeast of South Bend, where it terminated; its moraine commencing about one mile east of Notre Dame and a little south, forming the range of hills which commence at that point and extend in a general northeasterly direction, passing near Dowagiac, Decatur and Lawton, Mich., terminating west and north of Saginaw bay; this range of hills was the western and part of the southern terminal moraine of the Saginaw glacier, its eastern arm and part of its southern having been eroded and washed away by the great Illinois river.

From the above outline of the glacial borders, it will be noticed that South Bend is located where three great ice lobes met, the Maumee, Saginaw and Michigan, which permanently marked their existence by massive accumulations, forming rugged and permanent ranges of hills and highlands, that will constitute the contour of our locality for many thousands of years.

ANCIENT WATERWAYS

This brings us to the ancient waterways of our county. The melting of these vast fields of ice was conducive to great floods and torrential streams. South Bend being peculiarly located as to the three glaciers, it was also peculiarly located as to ancient streams. Where our city now lies nestling in a beautiful valley, partially surrounded by hills, a wonderful river once flowed, a stream three miles wide and one hundred feet or more in depth, flowing from east to west. And from the north a great tributary, whose mouth was three miles wide, emptied its waters into the main stream exactly at this point. If man could have stood upon the hills of Rum Village, a vast panorama of water would have met his gaze: to the east, water as far as the eye could see, and from five to six miles wide, passing at his feet and rolling onward to the southwest, confined only by the hills on the north and on the south; looking north, a tributary stream three miles wide and limited only by the horizon. And *primitive man was here.*

The stream to which I refer was the Great Illinois River, which had its origin at the margin of the Saginaw basin, or, more properly, was the outlet at the southwest corner of the great post-glacial lake which lay in southern Michigan, and whose western shore-line is so well marked from Kalamazoo to Constantine, passing just west of Schoolcraft and Three Rivers. The northern shore-line of this lake was the terrane leading east from Kalamazoo to near Ann Arbor, along which are located the cities of Battle Creek, Jackson, and Marshall. The Grand River valley, or drainage, lay just north of this terrane and supplied most of the waters for this lake, until the Grand river waters found an opening into the Michigan basin; this stream change caused the southern Michigan post-glacial lake to disappear, and its outlet, the present St. Joseph river, to become immediately much smaller and assume nearer its present capacity. After the ice sheet had withdrawn sufficiently to allow the waters to escape through the Mohawk valley, the larger portion was carried in that direction, which reduced the great Illinois river, that had formerly filled a channel many miles in width, to a stream less than a mile wide. About this time, or shortly afterwards, the waters found a new outlet into the Lake Michigan basin, leaving the Illinois valley at the point where South Bend now lies, through the bed of its once largest tributary, which will be described later on. The Illinois river valley was the great outlet for the waters escaping from the Maumee, Saginaw and the eastern border of the Michigan ice lobe, as the Wabash valley was the outlet for the waters of the southern margin of the Erie lobe. The great Illinois river valley with its flood plain varies in width from three miles at its narrowest point, which is one mile below South Bend, to about twenty at its broadest part, which is between Porter and Lake on the north, and Newton and Jasper counties on the south. The south bank of the valley from about six miles below South Bend, to near its source, is from fifty to one hundred feet high, while the north bank from South Bend to its source, is generally low and shelving. From South Bend to the Illinois line, or from



ST. JOSEPH COUNTY

Showing moraines and ancient and modern stream courses.

the point where the stream emerges from between the Maumee and Michigan moraines to its confluence with the Desplaines, the banks are low, generally not exceeding fifteen or twenty feet in height. On the south side of the old channel will be found quite an extensive sandy flood plain, extending from the border of the Maumee moraine southwestward covering almost the entire surface of Starke county, and the northern part of Pulaski, Jasper and Newton counties. On the north the main channel largely borders the Michigan moraine.

The great width of the stream from South Bend to the eastern part of Illinois was owing to three causes. *First*—The surface of the country through which this part of the stream flowed was destitute of rugged features, being a comparatively level, smooth surface. *Second*—The stream crossed the arched condition of the bed rock which extends in a northwesterly course across Indiana into Illinois; this rocky ridge produced a well marked rapids, similar to those of the Ohio river near Louisville, and also had a marked tendency to dam the waters and cause them to overflow a wide territory above, giving to this region, the general appearance of a great shallow lake having occupied its territory. *Third*—At South Bend, a tributary one-third its size was added to its volume.

The principal Indiana tributaries of the Great Illinois, were the Elkhart, Yellow, and Tippecanoe rivers, draining from the Maumee glacier, and what I am pleased to call, the Great Dowagiac river, now represented by the Dowagiac creek, which heads south of Kalamazoo, Mich., but the waters of whose ancient stream probably accumulated far north of that point, gathering all the glacial waters from the eastern slope of the eastern lateral moraine of the Michigan glacial lobe, forming a mighty glacial river, flowing south to a point just north of Niles, Mich., where it received a large tributary which had opened a way through the lateral Michigan moraine, and discharging its waters from the Michigan basin, which had not yet found an opening to the south, between the Michigan ice lobe and its moraine. The Dowagiac river after receiving the overflow waters from the Michigan basin, continued south and emptied its waters into the Illinois at the present site of the City of South Bend.

The old Dowagiac channel, where it empties into the Illinois channel, is three miles wide, with well-defined banks rising from fifty to seventy-five feet above the bed of the valley, the valley having been cut to bed rock and silted up about one hundred and twenty feet, leaving the above mentioned banks yet remaining. These great streams existed for long periods of time. The Illinois and the Dowagiac conveyed the glacial waters during the advance of the ice sheet, also during the period when it stood at its most advanced point and during its withdrawal, and until the Michigan ice lobe had sufficiently receded to allow the waters along its eastern border to escape through the Desplaines opening. This promoted a rapid lowering of the waters between the ice lobe and its terminal lateral moraine, and terminated the flow of waters from the Michigan basin into the Dowagiac river, leaving a broad, water-worn plain leading from the Dowagiac river back northwestward to the Michigan basin.

Here commenced a system of river robbing. The Dowagiac doubled upon itself at an angle of forty-five degrees, followed the abandoned channel of its former tributary and discharged its waters into Lake Michigan, leaving in turn a well-worn channel from three to four miles wide and eleven miles long, leading to the great trunk stream or Illinois channel. The distance from the point where the Dowagiac emptied its waters into the Illinois to St. Joseph, Mich., is thirty-eight miles, with a fall of one hundred and forty-one feet; from the same point to Momence, Ill., the distance is ninty-two miles, with a fall of ninety-three feet. It can be readily understood that, with the first annual flood, a part of the waters of the Illinois would follow the abandoned Dowagiac channel mingling with the Dowagiac, and onward into Lake Michigan at St. Joseph. The fall over the new route being three and a half times greater than that over the old route, the new channel rapidly cut through the old river deposit, finally claiming all of the waters of the once mighty Illinois, leaving its valley from South Bend to the Desplaines a geological monument to tell of its eternal past.

The physical force which most likely turned the current of the Illinois into the channel of the Dowagiac, was an Ice Gorge, forming seven miles below South Bend, where a jutting point from the Michigan moraine extends out into the valley proper two miles and a half in an almost transverse direction, known as "Crum's Point". Just below this point, we find an ancient flood plain two miles wide, which was supplied with overflow water from the Michigan basin, and which entirely subsided when the Michigan waters receded from the rim of its basin. This valley is drained by a small, meandering stream known as Grape Vine creek, the rudiment of a mighty glacial stream. Strong and well pronounced evidences of an ice gorge or dam having formed at Crum's Point and extending up the river to the mouth of the abandoned Dowagiac channel, are yet plainly visible from the scouring, leveling and erosion of morainic hills on the south, and a chain of lakes and lake beds on the north, which are connected by a gorge through the point with the glacial stream mentioned above; and also at the head of the ice dam, which passed well up above the mouth of the Dowagiac, where the waters, pouring around it into the Dowagiac valley, excavated an interrupted channel, or chain of depressions. These depressions are linear, extending from northwest to southeast, being from one-fourth to three-fourths of a mile long, twenty to forty feet deep and from two hundred to four hundred yards wide, with sharp and well-defined banks. They all show evidences of having been filled with water for a long period of time. All have become dry except the lower two (Notre Dame Lakes), which contain from twenty to thirty feet of water at present. This channel, or chain of depressions, extends from one mile north of South Bend southeasterly to within one mile of Mishawaka, a distance of four miles and a half, as shown on the accompanying diagram. When the ice dam gave way, the waters abandoned their circuitous routes and resumed their old channels, a part of them at this time taking the route down the Illinois and a part of them up the Dowagiac valley. The fall the latter way being three and a half times greater than the former, a channel was soon eroded sufficiently to carry the entire volume of water. A bluff twelve to fourteen feet high, which commenced in the form of a sandbar, the sediment for which was supplied by what is known as Wenger creek, extending in a diagonal direction across the Illinois bed and parallel to the new current until it reached the opposite bank, sealed the Illinois valley at this point forever; the early missionaries gave the name, St. Joseph, to this part of the valley.

The sandbar or bluff referred to is the shelf or hill extending diagonally through the city, upon which Tippecanoe Place is situated. This ridge was originally built by sediment from the creek, but was increased in height by erosion as the stream cut into its bed.

The swift current of the Dowagiac carried down large quantities of gravel, and as the gravel-laden waters came in contact with the waters of the Illinois, its velocity was checked and the gravel was laid down at its mouth, on the west bank, where the current remained the most swift. This gravel bed extends from the Michigan road up the river a distance of three or four miles, and is about one-half mile in breadth. It forms the eastern slope or border of Portage Prairie. This bed of gravel has been sounded in a number of places and found to be from forty to fifty feet in depth, and all smooth, rounded, water-worn gravel, placing at our city's gates an inexhaustible supply of the finest gravel for highway purposes. The Dowagiac river, hurling its great volume of water against the current of the Illinois, also had the effect of slowing down the current of the Illinois, and caused it to deposit its heavier material, which we find stored away in the form of acres of river gravel, just east of Mishawaka, which the New York Central Railroad Company is utilizing for road-bed purposes. The current of the east side of the Dowagiac river at its mouth was much more obstructed than the west side, consequently the gravel and coarser material was slowly laid down above, and only the finer material was carried to its mouth, where it was laid down as sand in great quantities, forming Lowell Heights, as shown by the deep excavations along the face of the bluff. If a careful examination of the sands is made, large quantities of small pieces of coal will be found, indicating that the Saginaw glacier had cut deep into the surface and uncovered, in places, the coal fields of Michigan and mingled their contents with the drift.

The Illinois river, from its source to its mouth, took a southwesterly course. When the waters left the old channel, they took an almost due northerly course, forming a great bend in the river, with its sharp convexity to the south, which gave our city its name, —South Bend.

The Illinois valley at South Bend, where it escapes from between the Maumee and Michigan moraines, is narrowed down to three miles, with high, rugged banks and no flood plain. Five miles east and up the valley from South Bend, it attains a width of six miles, which width it holds, with slight variation, until it reaches the rim of the Saginaw basin. This end of the valley is thoroughly drained by the channel of the present St. Joseph river, which has eroded through the old river drift to the extent of from forty to fifty feet. There are a few peat bogs and marshes lying back from the river, where the valley is broad and the modern channel well to one side. Otherwise, the old valley above South Bend is one vast, level sand-plain. Below South Bend, where the old valley remains silted up, and there is no modern channel for drainage, the spring waters escaping from beneath the Michigan moraine and from the foot of the Maumee, also bubbling up from the bed of the old stream itself, have been productive of a vast growth of peat or muck over the entire valley proper, from South Bend to Momence. Beneath this peat bed, which ranges from six to ten feet in depth, is found fine sand and river gravel, as shown by excavations made in the construction of a large ditch, made with the view of straightening the river. This ditch commences at South Bend, is twenty feet wide, ten feet deep and twenty miles long, which gives us a comprehensive idea of the materials underlying the bog. If the stream had not changed its course at South Bend and continued down its original valley, eroding a channel or partially cleaning the old silted valley to a depth of from fifty to sixty feet, as the waters have done through their new course, rendering to the Illinois valley thereby proper drainage, there would never have been known a "Kankakee Marsh," but all that portion of Indiana would have been a vast, sandy plain, covered with oak or barren timber, and in general would have had the same appearance as that part of the valley above South Bend.

We have glanced rapidly over the formative history of our continent,—from the primitive beginning to the birth of the Appalachian range, the oldest mountains of the continent; during the succeeding millions of years the coming of the western and youngest ranges of mountains, completing the great interior valley and its drainage; then the ice age, with its various advances, leaving its characteristic markings, our ranges of hills, highlands and valleys. These changes have been slow and imperceptible, but they are occuring as rapidly to-day as during the primeval past, and they will continue through untold ages, until every part of the earth's surface shall have been alternately dry land and sea, times without limit.